REMARKS

In the light of the objections raised by the Examiner, claims 21 and 33 have been amended to clarify that the substrates (or substrate elements in the case of claim 33) are spaced apart from each other. These claims have also been amended to clarify that there must be at least one complete turn of a surface coil defined on a single surface of each substrate. In the case of claim 21, the term "substrate element" has been replaced by a clearer term "substrate", and it has been clarified that these are discrete components (see Figure 3 below in this response).

The applicant respectfully submits that these amendments are only by way of clarification, as it had been clear from the arguments presented previously that the present invention proposes the use of several separate circuit boards each in a radial/axial orientation, and with coils which exist in their entirety on a single surface of such a circuit board. The geometry of the present invention is thus clearly distinguished from that of the citations by the following characteristics:

- the present invention has a number of discrete planar insulating substrates which are aligned with angularly spaced planes
- these substrates are spaced apart from each other (by virtue of this angular spacing)
- a surface coil with at least one turn is defined on a single surface of each substrate

None of the citations proposes a structure with these features. It will then be appreciated that claim 21 is further distinguished by the use of a twisted pair of wires to interconnect the successive coils on different substrates; and that claim 33 is further distinguished by using a single flexible substrate strip to form a plurality of substrate elements. The Examiner has provided no support for suggesting that the use of a flexible strip in this novel context, as specified in claim 33, is obvious (see Figure 4 below in this response).

The dependent claims have also been amended, where necessary, to avoid any ambiguity regarding antecedents.

Turning to the Examiner's assertions, the Examiner has suggested that Gris et al. (US 5,414,400) discloses a plurality of planar insulating substrate elements aligned with angularly spaced planes,

but this is not the case: Gris initially discloses a single planar substrate (see Figure 1 below in this response). The Examiner is equating the several discrete planar substrates of the present invention (see Figure 3 below in this response) with portions of the single substrate used by Gris – however, those portions are not spaced apart from each other, as they form part of a single planar substrate. In the embodiment where Gris has more than one substrate (see Figure 2 below in this response), these substrates are parallel. They are certainly not aligned with angularly spaced planes that are oriented in substantially axial and radial directions relative to the axis of the central cavity.

Further, Gris does not have any coil with a complete turn that is defined on a single surface of his substrate. In every case each turn is made up of conductive tracks on opposite surfaces of Gris's substrate, which are linked by vias, so there is clearly no complete turn on any one surface (the same applies to Karrer).

Geometric Comparison of Substrates without Conductors

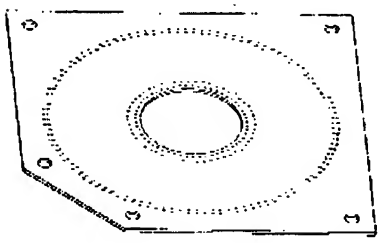


Figure 1

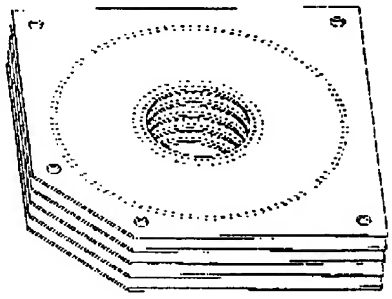


Figure 2

Gris et. al.

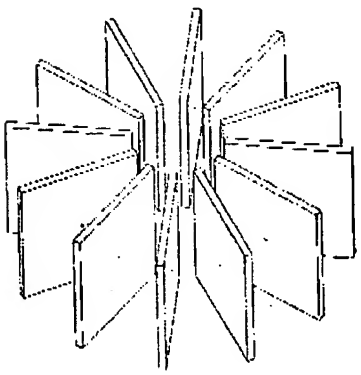


Figure 3

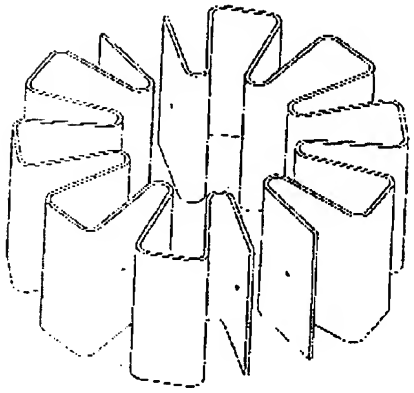


Figure 4

Present Invention

These figures show that the substrate geometry of the present invention is clearly quite different from that of Gris et al. (and Karrer et al.). In the one embodiment where Gris et al. use more than one substrate, these substrates are parallel to each other. Gris et al. have no angular substrate spacing.

Furthermore, in the case of Gris et al. (and Karrer et al.) the magnetic field lines run either parallel or at least approximately parallel to the substrate surfaces. In the present invention the magnetic field lines are at right angles to the substrate surfaces.

As regards the feature in claim 21 of the use of twisted pair of wires to interconnect the coils on the separate substrates, this is not equivalent to anything in either Gris or Karrer (US 6,624,624). Neither of these citations suggests use of several discrete and separate substrates with surface coils on them which are interconnected by twisted wires. The cited section at column 5 lines 51-67 is not referring to a twisted pair of wires, but refers to conductive tracks on a circuit board. This is quite evident from the statement (at column 5 lines 56-61):

> "The conductive tracks on the underside of the circuit board 15 may be interconnected to tracks on the upper side of the circuit board by, for example, means of vias or plated through-holes 19, as is known for example from conventional designs."

and this is also quite evident from Karrer's Figure 4 to which this section refers.

While the prior art does teach the use of wire in the construction of toroidal coils, the hybrid approach of combining printed circuit board coils with twisted pair wire interconnections is unprecedented. Were it obvious, it would surely have been featured in at least one of Karrer's no less than 13 embodiments, given that it provides superior noise immunity to what either Gris or Karrer teach (see previous response for details), and given that noise immunity was clearly sought after by Karrer et al.

As regards claims 22 and 34, these claims require that the surface coil (defined in the preceding claim) comprises a conductive track. Since neither citation has a complete turn of a coil that is on a single surface, these claims are clearly not anticipated. Similarly, as regards claims 23 and 35, these require there also to be a surface coil on an opposite surface of the substrate. Since neither citation has a coil with a complete turn that is on a single surface, this claim is also clearly not anticipated.

Claims 25 and 37 have been amended to clarify the arrangement of the turns. This arrangement is clearly shown in Figures 2, 6, 7, 12, and 13 of the present application. Neither Gris nor Karrer have this arrangement in any of their embodiments. These claims require that each said surface coil includes a plurality of progressively smaller nested conductive turns on the surface of the substrate. Such nested turns that are on a single surface of a substrate are not suggested by either

of the citations. The Examiner has suggested that nested conductive turns are shown in figures 13-15 of Karrer et al., but this is not the case – on any one surface there are merely straight tracks (which connect to tracks on the opposite surface to form a turn). These claims clearly specify a novel design.

As regards claims 28 and 40, the Examiner has asserted that it is inherent that substrate elements are all spaced at equal angles, which clearly shows that these claims are non-obvious, as the claims require that the substrates are uniformly spaced at unequal angles. (This embodiment is discussed on page 6, paragraph 31, of the present application.)

In relation to claims 29-32 and 41-44 (which relate to the housing), the Examiner has additionally cited Fernandes (US 4,855,671). This describes a system in which current in a conductor is measured using a conventional toroidal Rogowski coil (component 104), and this device precludes the need for communication between modules (column 2 line 57). As shown in Figure 3, the device incorporates a housing consisting of four parts 40, 42 hinged so the module can be placed over a conductor (column 5 lines 59-62 and column 6 lines 19-21).

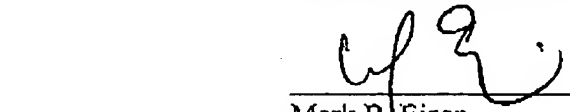
As regards claims 29 and 30, and claims 41 and 42, these are valid by virtue of being dependent upon a valid claim. As regards claims 31, 32, 43 and 44, these claims specify that there must be a separation distance between the mating surfaces of the sections of the housing, and the planar substrates that carry the coils. In contrast, in Fernandes, no information is given about the spacing between the mating faces of the sensing coil 104; and as regards the power-generating coil 88, this is said to close with a minimum air gap (column 7 lines 1-2). This actually directs the skilled person away from the present invention, as trying to minimize the gap is the opposite concept from ensuring there is a separation distance! This citation provides a totally different coil structure to that of the present invention, and in particular it does not use a plurality of planar substrates that are spaced angularly apart. Since none of the cited prior art describes a current sensor with these geometrical characteristics, it can hardly be obvious to combine the novel and inventive sensors of the present invention with a housing in the way specified in these claims.

For the above reasons it is submitted that the present claims should be allowable.

Favourable reconsideration and allowance of this application are respectfully requested.

Executed at Toronto, Ontario, Canada, on April 18, 2005.

ERIC GEORGE DE BUDA



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